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Pesticide Use Observations Monterey County California, April 29-May 2, 1977

(U.S.) National Enforcement Investigations Center, Denver, CO

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PESTICIDE USE OBSERVATIONS

MONTEREY COUNTY, CALIFORNIA

APRIL 15 - MAY 1, 1971

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From April 29 to May 2, 1977 a pesticide use observation was conducted by the National Enforcement Investigations Center(NEIC) on a lettuce field in Monterey County, California. During the observation, an EPA study team evaluated the activities associated with the aerial application of Phosdrin to control an infestation of aphids.

The use observation study in Monterey County revealed exemplary storage and handling procedures.

The pesticide use was consistent with label instructions;however, the close proximity of sensitive areas (an elementary school yard and farm labor residences) created a potential health hazard.

The study indicated a need for the EPA, state and local officials to initiate measures to protect humans and beneficial animals in areas near spraying operations. Measures should include, but not be limited to, regulating activities more closely during and after pesticide application and establishing regulations which restrict access to pesticide application areas. Currently, the State of California has a permit system in effect in whi which all of the above issues should be addressed.

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PESTICIDE USE OBSERVATIONS
MONTEREY COUNTY, CALIFORNIA

(April 29-May 2, 1977)

August 1977

National Enforcement Investigations Center
Denver, Colorado

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I. INTRODUCTION

Modern agriculture has become increasingly dependent upon the use of chemical pesticides to increase crop production. As part of an ongoing National Pesticide Use Observation Program to assess hazards associated with pesticide use, the Environmental Protection Agency (EPA) has performed monitoring activities in several parts of the country. Monterey County, near Salinas, California, was selected to represent a major food crop production area. An 11 ha (27 acre) field containing mixed lettuce was selected by EPA personnel in conjunction with State and local officials because of its close proximity to schools and residential areas and the high potential for environmental degradation.

The primary objectives of the investigation were to:

1. Determine whether field applications of pesticides are consistent with label requirements and appropriate regulations.

2. Develop, modify and refine methods and technology by which the potential environmental hazards associated with the proper application of pesticides can be assessed.

3. Determine the extent and effect of pesticide drift from target areas onto nontarget areas.

4. Document the efficiency of a closed-system pesticide transfer operation.

A four-day pesticide use observation began April 29, 1977. A mixture of two pesticides, Phosdrin* and Dipel,* plus the "sticker-spreader" Nu-Film-P* was applied by helicopter to the lettuce field on May 2, 1977.

Emphasis of the study was to observe the application of Phosdrin, a Class I pesticide under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Dipel, which is a biological insecticide, contains the active ingredient *Bacillus thuringiensis*, Berliner and is categorized Class IV under FIFRA regulations. Dipel is exempt from tolerance requirements when applied to crops listed on the label according to directions for use. Nu-Film-P causes the pesticide to adhere to foliage and reduce erosion of spray residue by rainfall or overhead irrigation.

The study included sampling of ambient air, water, and soils in the field being treated with pesticides and in surrounding areas. Storage, handling, mixing and application of the pesticide were observed. Weather conditions were monitored during and after the pesticide application. Various types of spray droplet cards, placed both vertically and horizontally, and high-volume air sampling devices were used to characterize spray drift.

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* *Trademark, see page 14.*

II. SUMMARY AND CONCLUSIONS

From April 29 to May 2, 1977, a pesticide use observation was conducted by the National Enforcement Investigations Center (NEIC) on a lettuce field in Monterey County, California. During the observation, an EPA study team evaluated the activities associated with the aerial application of Phosdrin to control an infestation of aphids.

GENERAL CONCLUSIONS

The use observation study in Monterey County revealed exemplary storage and handling procedures.

The pesticide use was consistent with label instructions; however, the close proximity of sensitive areas (an elementary school yard and farm labor residences) created a potential health hazard.

The study indicated a need for the EPA, state and local officials to initiate measures to protect humans and beneficial animals in areas near spraying operations. Measures should include, but not be limited to, regulating activities more closely during and after pesticide application and establishing regulations which restrict access to pesticide application areas. Currently, the State of California has a permit system in effect in which all of the above issues should be addressed.[1]

SPECIFIC CONCLUSIONS

1. During pesticide application, potential human health hazards were observed. An elementary school yard adjacent to the target field contained numerous children; nearby residents

were not notified during spraying operations; and farm roads bordering the target field were not posted during spraying. Pesticide drift was observed to occur in both the school yard and the residential area.

2. Analyses of two soil samples and one water sample collected from the school yard and the farm labor residence areas revealed measurable amounts (0.02 to 0.03 µg/g and 0.9 µg/l, respectively) of Phosdrin. Analyses of spray indicator cards and high-volume sampling devices placed in these areas showed Phosdrin contamination. The contamination of the areas was directly attributable to spray drift. Phosdrin levels detected in these areas were lower than acceptable tolerance limits on lettuce eaten raw;[2] (0.5 mg/kg) or 0.1 mg/m^3 in air in working environments[3] (8-hr/day, 40-hr/wk occupational exposure).

3. During and following the application, 8.0 µg of Phosdrin was detected in a high-volume air sampler placed on top of the Alisal High School, approximately 1.2 km (0.7 mi) north of the target field; 6.5 µg of the pesticide was detected near the mixing and loading site approximately 0.5 km (0.3 mi) southwest of the target field. However, these residues could not be attributed directly to the observed application.

4. Officials at the elementary school reported no increase in absenteeism or illnesses, indicating that the observed application had no discernible acute impact upon the health of the school children.

5. The use of the closed system of pesticide transfer incorporated features that are beneficial for the protection of worker safety.

The system also reduces the number of necessary health examinations because workers have less exposure to toxic chemicals.

6. Observations and interviews by EPA personnel indicated that the applicator was conscientious and well informed of the proper use of pesticides. The aircraft pilot exercised good judgement and used great care to minimize drift by attempting to spray farther away from the sensitive areas than other borders of the field.

7. The pest management program performed by the pest-control adviser during this application was reported to be successful. Crop damage by the aphid infestation was minimal. Application rates were less than the maximum concentration allowed by the label which was both economically and environmentally beneficial.

8. During this study the use of spray indicator cards to characterize pesticide drift potential was not successful. Heavy dewfall before and during the application caused the cards to become saturated with moisture which obliterated droplet impressions.

9. Pesticide residue analyses of Thermofax paper proved useful during this study. However, because of the moisture on the paper, values reported are considered to be conservatively low.

III. BACKGROUND

Monterey County lies along the coast of central California [Figure 1] encompassing more than 8,600 km^2 (3,300 mi^2). In 1976, Monterey County's gross farm income totaled more than $453 million. It ranks among the top ten counties in gross farm income in California and among the top twenty in the United States.

The 137 km (85 mi) long Salinas Valley comprises most of the agricultural area in Monterey County. Rich soils, plentiful and high-quality irrigation water obtained from underground percolating streams, an average yearly rainfall of 36 cm (14 in), and a long and favorable growing season help to make the Salinas Valley one of the richest agricultural areas in the world. Crop production is extremely diverse in Monterey County. Fresh vegetables are the major agricultural commodity. Other crops include fruits, grapes, nuts, field crops such as sugar beets and grains, seed crops and cut flowers. The largest commercial crop in the county is lettuce, comprising more than $155 million of $311 million receipted for vegetable crops in 1976. Salinas Valley is often referred to as the "Salad Bowl" of the nation.

During any month of the year, planting, cultivating and harvesting may be observed. Extensive use of crop rotation is practiced so that during any two-year period most cultivated land will produce a series of three different food crops. Additionally, cover crops are planted to preserve soil conditions prior to planting of commercial crops. As in most highly developed agricultural areas, pesticide use is greatly relied upon to insure maximum production from the land.

Lettuce was chosen as the target crop to be studied during this investigation. Various insect pest infestations may occur from the

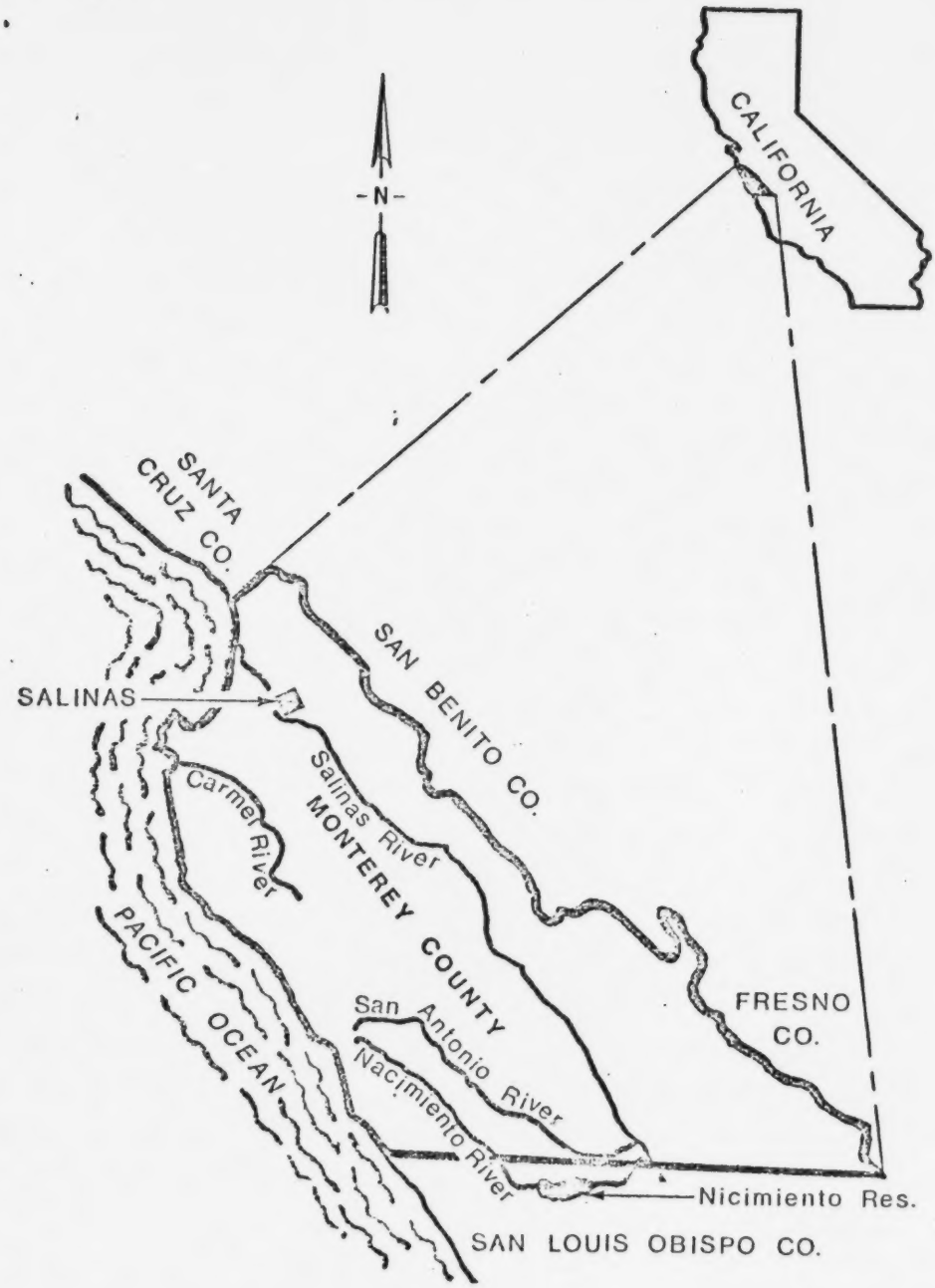


Figure 1. Monterey County, California

time of planting until harvest. After an insect infestation has been identified, spraying with insecticides will be initiated and repeated as necessary until a few days prior to harvest.

Most owners of large farms in the Salinas Valley utilize the services of licensed agricultural pest-control advisers. The pest-control adviser has complete responsibility for identifying insect infestations, making arrangements for application, selecting the proper pesticide and indicating the rate of application. In other cases, the adviser merely identifies insect populations and recommends a pesticide application. The landowner must then make arrangements for the purchase and application of the pesticide.

Monterey County averages between 30,000 and 40,000 individual applications annually. Because of this high intensity spraying throughout the valley, landing strips are strategically located in areas of the most intensive spraying. Mixing and loading operations are performed with use of large-capacity mobile nurse rigs. The nurse rigs rendezvous with the aircraft at a landing strip near the target field. Dilution water, pesticides and other materials are carried aboard the nurse rigs which are capable of performing complete mixing and loading operations.

IV. DESCRIPTION OF STUDY AREA

The site selected for pesticide use observations was an 11 ha (27 acre) rectangular field planted with mixed lettuce. The field was bordered by an elementary school and playground, farm labor residences, a public highway and other fields containing lettuce, cabbage and fallow ground. Located within a 3 km (2 mi) radius of the lettuce field site is a public high school, ranch buildings (containing offices and ranch equipment), the Salinas Municipal Airport and a residential portion of the City of Salinas, California. Farm roads are located throughout the area to provide access of vehicles and equipment to the fields for irrigation, cultivation, and harvesting.

Fifty-one stations were established in the study area [Figures 2, 3, Table 1]. Two stations (25 and 32) were on the target field. The remaining 49 stations were off the field in areas where excessive drift would be of concern, including the elementary school and playground, the high school, local residences, the airport, and ponds located in the area. Samples were collected from all stations except 29 and 50 which were established during the reconnaissance but later eliminated. Indicator cards at station 30 were destroyed by school children playing inside the playground.

The NEIC weather station was at the southwestern corner of the target field near station 38 [Figures 2 & 4]. Wind directions, wind velocities and air temperature, at 2m (8 ft) and 10m (32 ft) heights to determine lapse rates, were monitored.

Honeybees were to be held in cages near the treated field in an attempt to monitor effects of pesticide drift beyond the target area. Excessive mortality of the test bees prior to the pesticide application precluded their use for bioassay evaluations.

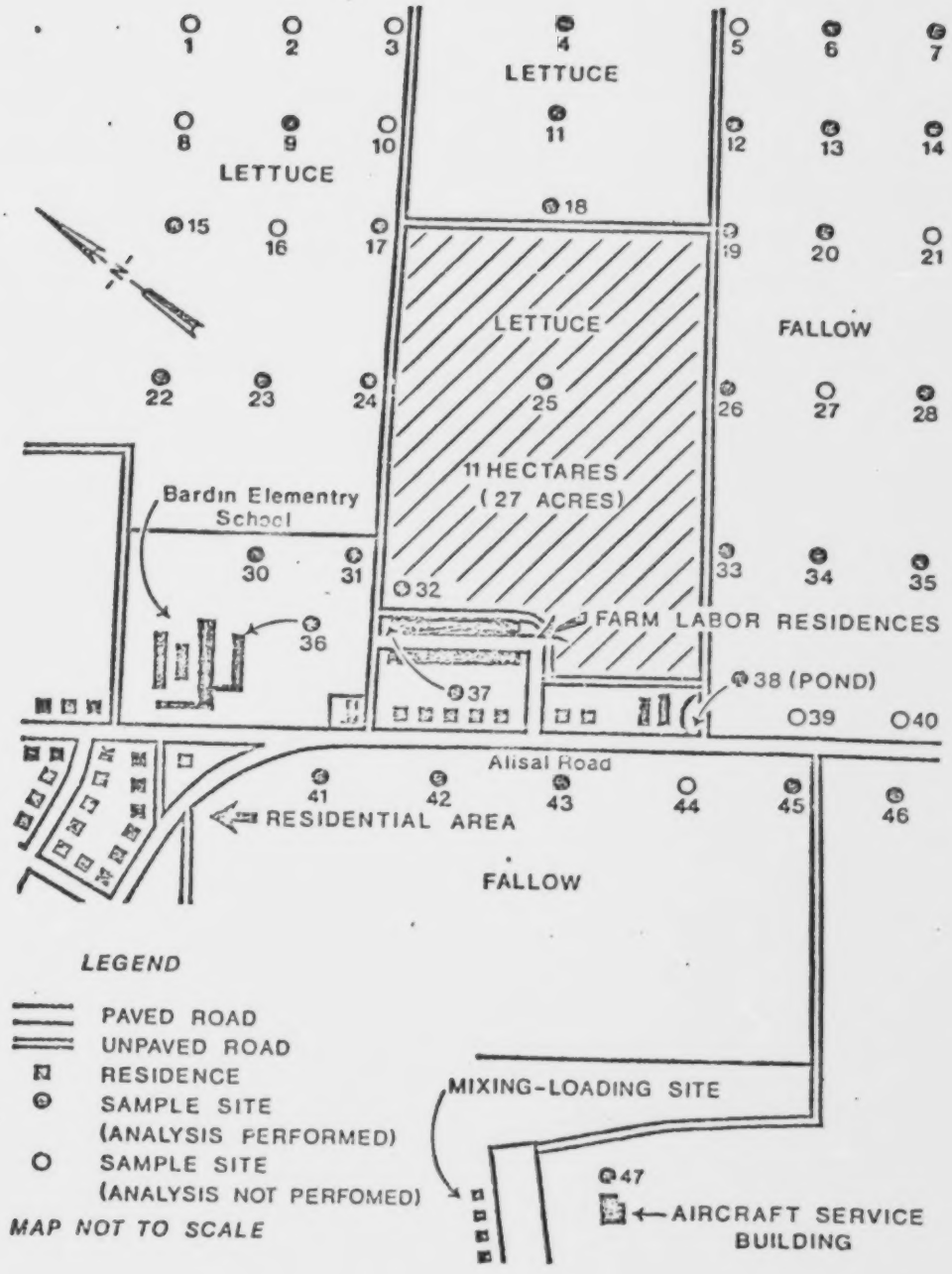


Figure 2. Station Locations - Monterey County, California May, 1977 (for additional sampling sites see Figure 3.)

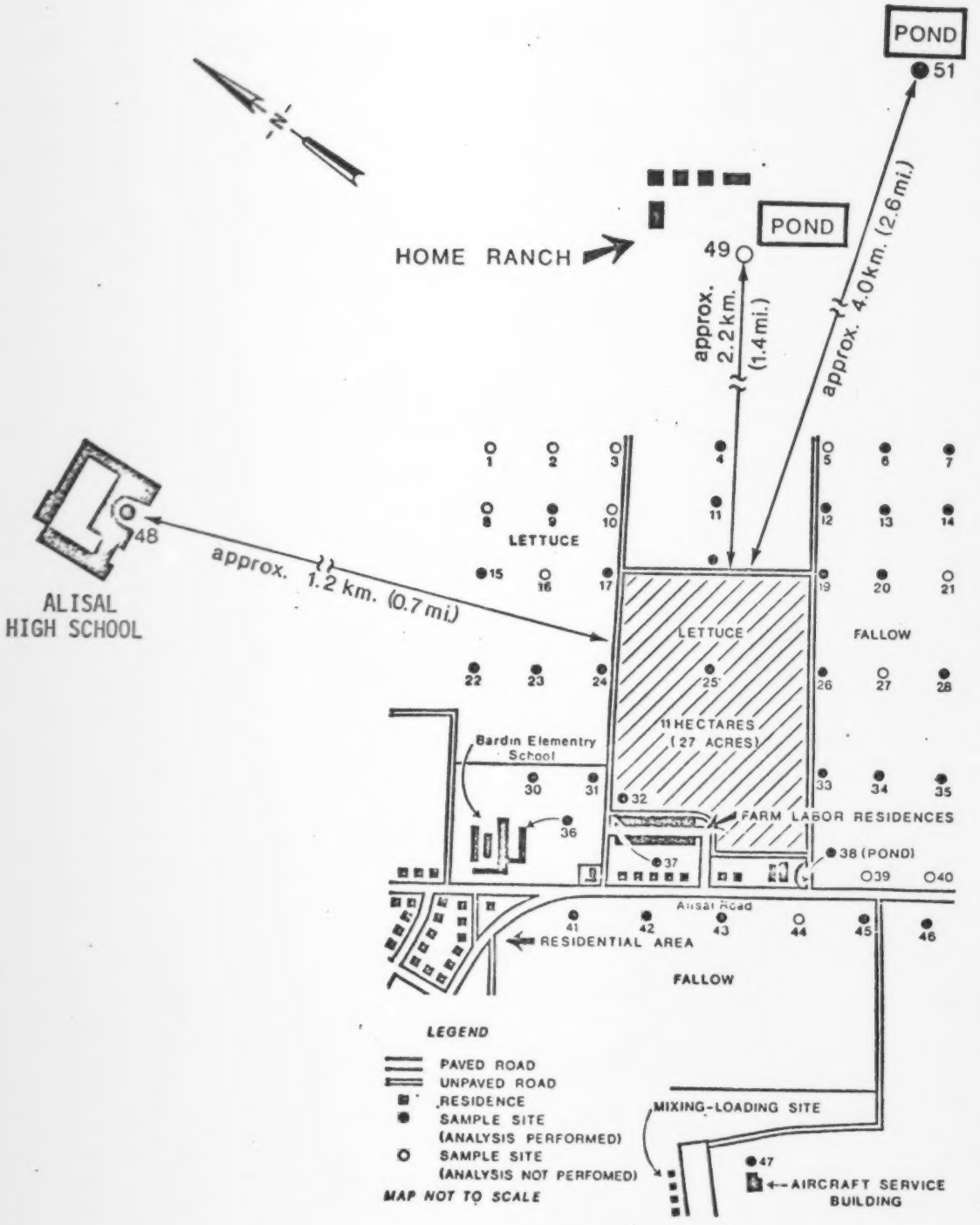


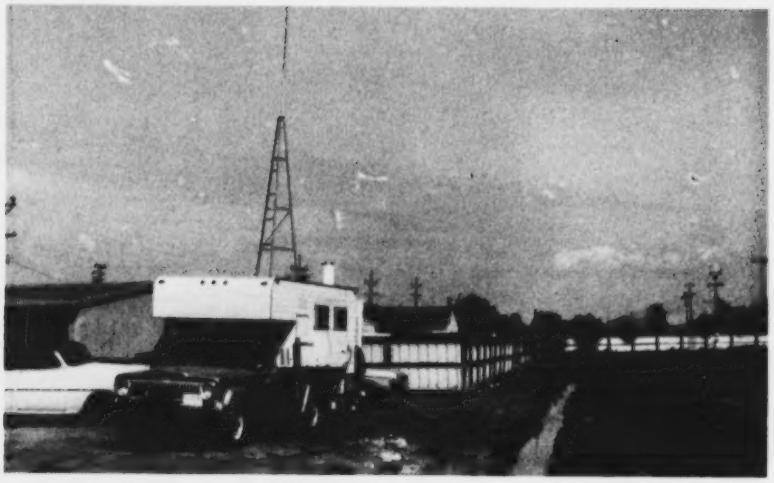
Figure 3. Additional Station Locations
Monterey County, California May, 1977

Table 1

SAMPLING STATIONS AND DEVICES
Monterey County, California
May 1977

Station No.	Indicator Cards†	High-Volume Sampler	Water	Soil
1-17	X			
18	X	X		
19-23	X			
24	X	X		
25	X			
26	X	X		
27	X			
30				
31	X			X
32		X		X
33-35	X			
36	X	X		
37	X	X		
38	X			X
39-46	X		X	
47	X	X		
48	X	X		
49	X			
51			X	

† *Kromecote, Thermofax, Linagraph.*



A. EPA mobile meteorological laboratory.

B. Two-meter temperature probe with anemometer and weather vane.

Figure 4. EPA weather monitoring station.

V. USE OBSERVATION

PRE-APPLICATION

Detecting Infestation

The agricultural advisor examined the study site on April 29, 1977. He determined infestation by a random examination of several lettuce plants throughout the field. According to the advisor, it is characteristic for an insect infestation to begin in the same portion of the fields as it has in the past several years. Therefore, past history and experience with a particular field serve to aid in determining potential pest problems.

The examinations showed an infestation of aphids. To control these pests, the advisor recommended aerial application of a mixture of 1.8 liters/ha (1.5 pt/acre) of Phosdrin*4E, 2.7 kg/ha (0.5 lb/acre) of Dipel** and Nu-Film-P*** at 0.29 liters/ha (0.25 pt/acre). Phosdrin was suggested to kill the aphids; Dipel would prevent future larvae infestations; and the Nu-Film-P, a "sticker-spreader," would prevent erosion of the pesticide mixture from foliage during rainfall or overhead irrigation. An application rate of 140 liters/ha (15 gal/acre) was specified.

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* *Phosdrin is a registered trademark of Shell Chemical Company; EPA Registration No. 6973-12AA.*

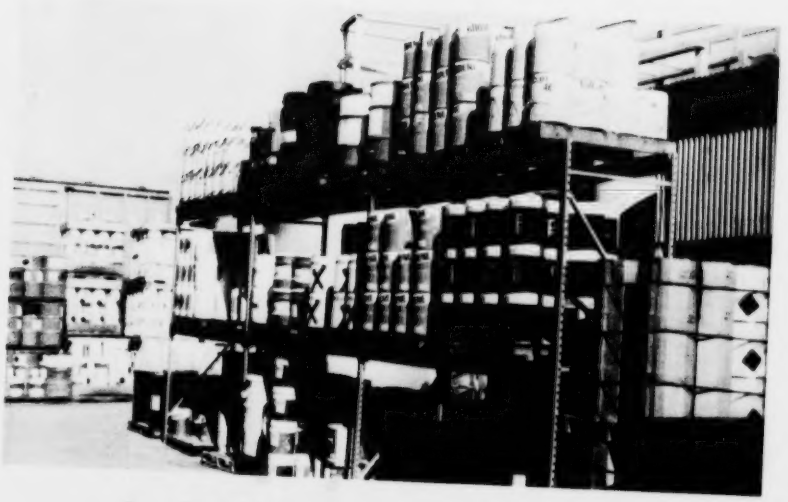
** *Dipel is a registered trademark of Abbott Laboratories; EPA Registration No. 275-18-AA-50546.*

*** *Nu-Film-P is a registered trademark of Miller Chemical and Fertilizer Corporation; California Registration No. 72-50003-AA.*

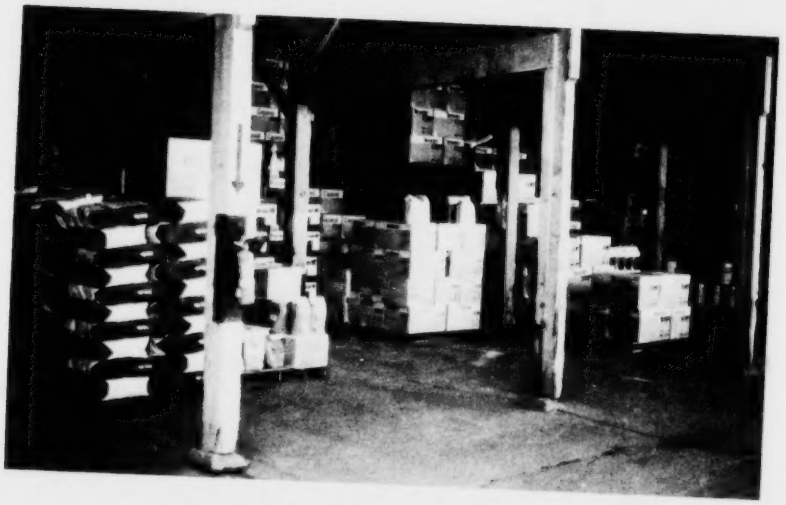
The landowner was notified on April 29, 1977, that the intended application was to occur May 1, 1977. Precautionary requirements were detailed on an Air Delivery Record addressed to the landowner, dated April 29, which read "Do Not Harvest within 4 days from Application." This precautionary period was more restrictive than label requirements. The Phosdrin label stated that the harvest limitation for lettuce at a dosage of 1.17 liters/ha (1 pt/acre) is 2 days; for 2.34 liters/ha (1 qt/acre) the harvest limitation is 4 days. It was noted also that the Air Delivery Record called for application of pesticide to an 11 ha (27 acre) lettuce field. However, the aerial application work order requested a mixture for 24 acres. The applicator intended to use extreme care near the sensitive areas at the southwestern and western end of the field. This area was not trimmed as closely as other borders of the lettuce field. Therefore, EPA observers estimated that only 24 acres of the field were treated. Since the amount applied was less than the maximum concentration permissible by the pesticide label, and which experience had shown to be effective, the advisor demonstrated good and safe judgement, which was beneficial both economically and environmentally.

Pesticide Facility

The pesticide was applied by a local firm (advisor, formulator and applicator combined). Corporate offices and pesticide storage facilities were located in Salinas, California; the latter were visited by NEIC personnel during a reconnaissance survey on March 16, 1977. The facility was modern, clean, and well ventilated [Figure 5]. Chemicals were arranged according to general types of compounds and further organized into specific types and brands. Storage facilities contained well defined passageways and adequate working space. The entire plant site was kept under security conditions. Areas were properly defined as to contents of buildings and containers. Precautionary signs included "No Smoking" and "Authorized Personnel Only." The pesticide dealer appeared to be making every effort to comply with Occupational Safety and Health Administration



A. Outside storage area for weather resistant containers.



B. Indoor pesticide storage facility.

Figure 5. Pesticide storage facilities.

(OSHA) requirements. Company officials indicated that all employees routinely received physical examinations including acetylcholinesterase (AChE) evaluations to determine if workers have been exposed to excessive amounts of pesticide.

The mixing and loading site was at the east end of the Salinas, California Municipal Airport, about 500 meters southwest of the study field. The site included several fenced enclosures, belonging to various pesticide companies, which were used for temporary storage of used pesticide containers. The fenced storage facilities were properly posted with precautionary signs and secured [Figure 6].

Mixing and Loading

At 0600 hours on May 1, 1977, the day of the scheduled pesticide application, a nurse rig and company workers arrived at the mixing and loading site. However, it was discovered that sabotage had been attempted on several aircraft used for spraying pesticides. This incident necessitated rescheduling the pesticide use observation to May 2.

At 0400 hours on May 2, 1977, the nurse rig was again dispatched to the mixing and loading site and pre-application operations began. The nurse rig consisted of a large capacity tank truck and a trailer containing the mix tank. Attached to the truck were several 115- and 210-liter (30- and 55-gal) drums containing pesticides.

The pesticide mixing and loading apparatus used by the applicator was a closed system which complied with the State of California Pesticide Worker Safety Regulations for pesticide transfer.[4] With this type of operation, the liquid pesticide concentrate was transferred by vacuum into a measuring tank and then to the final spray tank without exposure of personnel to the liquid pesticide. The system is capable of rinsing the emptied pesticide container, also. For the larger-volume containers,

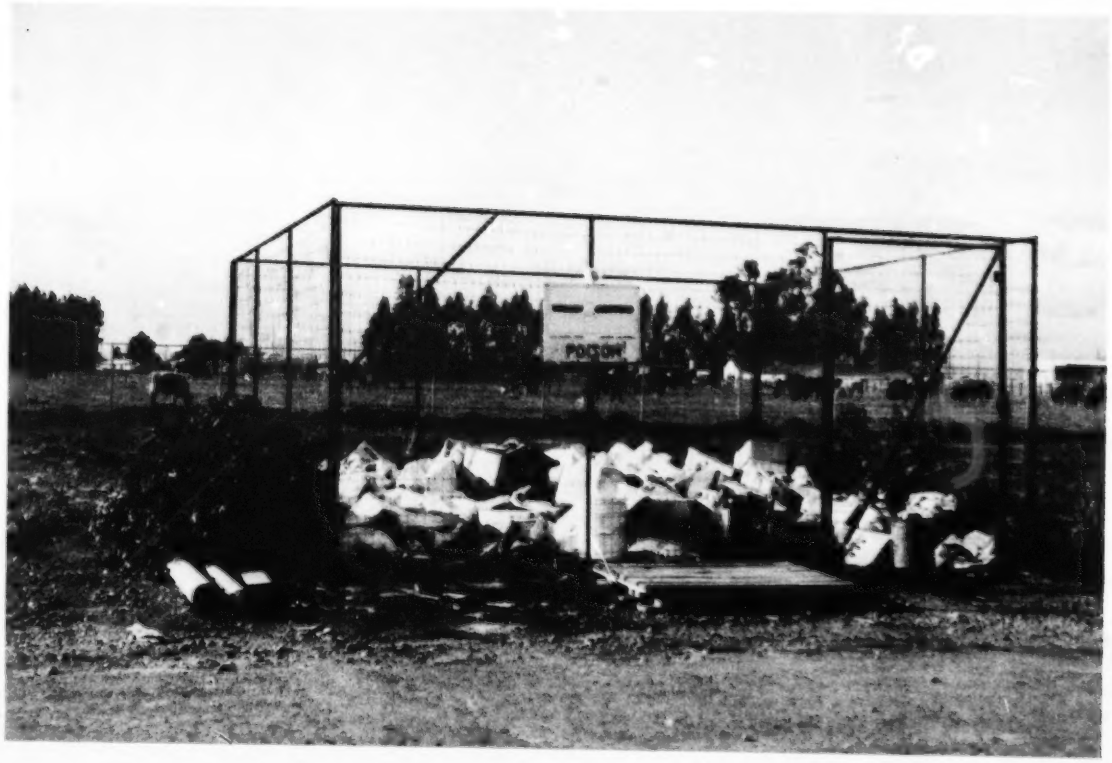


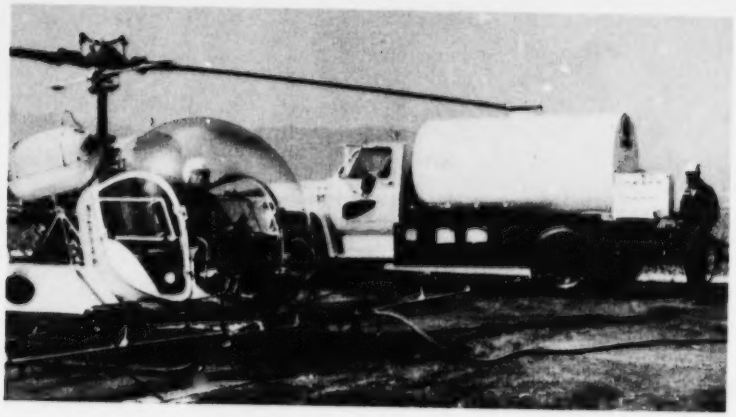
Figure 6. Temporary storage facility for used pesticide containers.

the closed system was equipped with a "breakaway" suction tube which left the exposed portion of the probe inside the partially emptied containers. Additionally, the system permitted the transfer of toxic dry materials to the spray tanks through a wettable powder box [Figure 7].

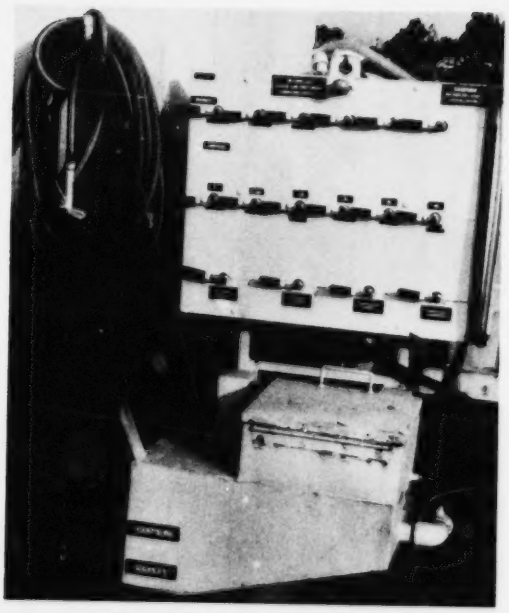
The mixing and loading operation was performed in an exemplary manner. Only one worker performed the operations. This employee wore proper safety equipment consisting of hat, long-sleeve coveralls, boots, gloves, face shield and respirator. The worker appeared to be very conscientious, neat and familiar with his job. Two batches of mixed pesticide were prepared. First, approximately 380 liters (100 gal) of water was pumped from the 5,700 liter (1,500 gal) capacity nurse rig tank into the 1,020 liter (270 gal) stainless-steel mix tank. Next, 13 kg (6 lb) of wettable, powdered Dipel was added to the hatch opening at the top of the tank and the mixture was agitated; then 0.95 liters (0.25 gal) of the "sticker-spreader," Nu-Film-P, was added.

The mix tank hatch was closed and 8.5 liters (2.25 gal) of Phosdrin was pumped from a 115-liter (30-gal) drum to the mix tank through the closed system. Water was then added to the mixture to obtain a final volume of 760 liters (200 gal). Water and Phosdrin were pumped through the closed system only. A calibrated sight tube was used for accurate measurement. The only observable aerosol that occurred was when the wettable powder, Dipel, was poured into the mix tank hatch opening. However, the loss was very minimal. All hazardous material transfer and rinse operations were performed by the worker using a console panel of valves. The aircraft pilot did not participate in the mixing and loading operations, and remained a safe distance away from the work area.

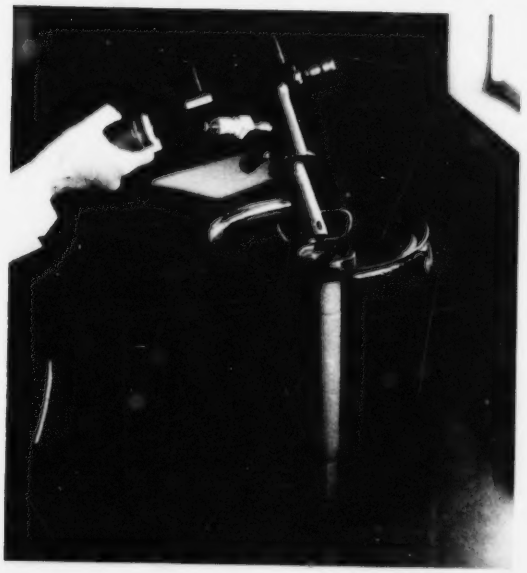
The mixture was agitated for approximately 20 minutes before it was pumped into the aircraft spray tank. One hundred gallons of mixture was added to the spray tank. Each batch provided for two 380-liter (100-gal) loads of pesticide mix.



A. Helicopter being loaded from nurse rig.



B. Portion of closed mixing system showing console panel of valves for liquid pesticides (top) and wettable powder box (bottom).



C. Cutaway of 19 liter (5 gal) container showing breakaway probe. Exposed portion of probe remains inside the sealed container.

Figure 7. Mixing and loading.

A heavy-gauge flexible hose was used to pump the spray mix into the aircraft tank. No visible leakage occurred. When the hose was uncoupled from the aircraft, only a few drops of liquid were seen to drip onto the ground. During the aircraft loading activity, pesticide formulation samples were collected for comparison with labeling and other applicable regulations. Later analysis of these samples revealed that the formulations were chemically in compliance with State and Federal regulations. Phosdrin concentrate analysis revealed label claims to be accurate.

The use of the closed system of pesticide transfer would be desirable in all commercial pesticide mixing operations. The system appears to provide worker safety features that far exceed batch mixing procedures.[5,6,7,8] It affords fewer precautionary measures, and in hot and humid weather it is beneficial to worker safety and comfort. The system reduces the number of health examinations that would be otherwise necessary, because workers have less potential exposure to toxic chemicals.

FIRST APPLICATION

Preparation

On April 30, 1977, high-volume air samplers were placed on and surrounding the target field at eight locations [Figure 8]. On May 1, these automatic samplers were operated for approximately 2 hours to collect ambient air which would be analyzed later for background levels of Phosdrin. Water samples were collected for the same purpose during this time, also.

Approximately 3 hours before the scheduled pesticide application on May 2, drift indicator devices were placed in and at various distances from the lettuce field. Station site locations were selected to monitor potential contamination of the surrounding area. The indicator devices consisted of Kromecote, Linagraph and Thermofax cards fastened

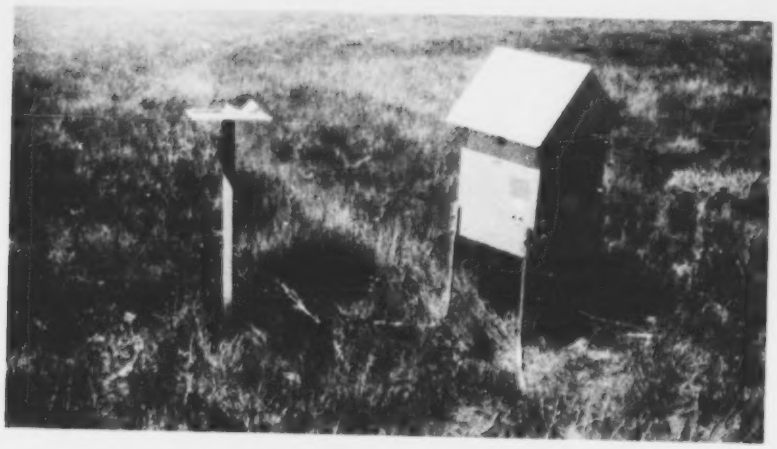


Figure 8. (l to r) Platform containing spray droplet cards (vertical placement of cards not shown); high-volume air sampling device.

Figure 9. Protected worker examining high-volume air sampling device.

both horizontally and vertically to wooden racks. High-volume air samplers were started.

Members of the observation team were stationed at strategic locations near the field to observe the application. All team members were wearing appropriate safety equipment consisting of long-sleeve, tightly woven coveralls, hats, boots, gloves, eye shields and canister-type respirators [Figure 9].

Application

The application began at 0705 hours on May 2, 1977. NEIC weather station data indicated winds were calm, with an occasional northeast wind of 3.2 km/hr (2.0 mph). Ambient air temperature was 10.4°C at both 2 and 10 meters.

The aircraft used was a Bell helicopter-47-G5. The 11 m (36 ft) spray boom was equipped with 32 Fan Jet* nozzles evenly spaced [Figure 10]. Boom pressure was set at 2.9 to 3.2 kg/cm^2 (42 to 45 psi). The aircraft operated at a speed of 61 to 65 km/hr (38 to 40 mph) approximately 1.2 m (4 ft) above the field surface [Figure 11]. Passes were made in a southwest to northeast direction, parallel to the lettuce rows and returned in a northeast to southwest direction. The pilot made a total of sixteen passes, two of which were used to trim the northeast end of the field. Two loads of the pesticide mixture were sprayed, averaging 5 minutes per load, with a 5-minute period to refill the helicopter spray tank between loads. The aircraft pilot was extremely careful to avoid spray drift into the farm labor residential areas. During each pass, spraying was terminated more than 30 m (100 ft) before reaching the southwest end of the field where the residences were located. No instance of visible drift was seen to enter the sensitive areas surrounding the field during the first portion of the application.

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* *Fan Jet is a registered trademark of Delavan Manufacturing Company.*

Figure 10. Bell helicopter equipped with spray boom.

Figure 11. Aerial pesticide application at the 1.2 meter flight level.

When approximately one-half the field was treated, the pilot reported a gasline leak on his aircraft. The application could not be completed until the malfunctioning helicopter was repaired; consequently, the spraying operations were discontinued temporarily.

Operation of all high-volume samplers was discontinued within one hour after the termination of this partial pesticide application.

SECOND APPLICATION

Preparation

After the first spraying operation had occurred, it was evident that the area sprayed was much less than the field area that the EPA had set up to observe. Contact was made with the applicator who indicated that the lettuce crop consisted of two fields and that the southern field was the application target area. Since winds were relatively calm and from the northeast at the time of application, and the nearest and farthest station locations bordering the northeastern end of the field were more than 120 and 490 m (400 and 1,600 ft) from the target field; it was improbable that drift could be effectively measured at the existing stations. Sampling equipment locations were adjusted to more closely monitor the actual target field. Operation of high-volume air samplers was initiated once again within 1 hour before the second application.

Application

The second spraying operation began at 1050 hours. The pilot performed the second application in a manner similar to the first. Two loads applied in ten passes by the helicopter were sprayed onto the remaining untreated portion of the field; two passes were used to trim the southwestern edge of the field next to the sensitive areas.

NEIC weather station data indicated that wind direction was extremely variable with an average speed of 3.2 km/hr (2.0 mph) throughout the second application. At the start of the application, wind direction was north to south at 4.8 km/hr (3.0 mph). The spraying required approximately 20 minutes. During this time, wind direction changed to northeasterly, into the farm labor residential area.

During the operation, the EPA team observed visible drift passing into two sensitive areas. In one instance observers reported a drift cloud passing into the farm labor residences as the aircraft was pulling up to avoid the residence area. On another occasion a cloud was observed being carried by wind currents into the residential area after the spray boom had been shut off. Finally, drift was seen to enter the school yard as a result of the vortex from the helicopter as the pilot sprayed the edge of the field.

POST-APPLICATION

Samples of water and soil were collected within 3 hours after application. Soil samples were collected on the school yard and at the farm labor residences near stations 30, 31 and 37. Water samples were collected from ponds at stations 38 and 51. Samples collected from station 51 were used for analyses to determine Phosdrin as well as other pesticide residues that might be persisting in surface waters. The remaining post-application samples were used to determine drift beyond the target field. High-volume air samplers were operated for 3 hours following pesticide spraying. Other drift sampling systems were collected within 3 hours after application was completed.

The ambient air temperatures and the dewpoint temperatures were exactly the same for 5 hours preceding the application. This weather condition resulted in heavy dewfall the morning of the pesticide application.

Consequently, all indicator cards became saturated with moisture, precluding pesticide spray characterization by droplet impressions on the cards. Nevertheless, residue analyses of the Thermofax paper confirmed drift of Phosdrin beyond the lettuce field.

All stations located within 6.0 m (20 ft) of the field showed measurable residues [Figure 2, Table 2]. Pesticide drift was detected on Thermofax paper 90 m (300 ft) east of the field at station 12 and 20 (0.25 and 0.2 µg, respectively) on the fallow ground. Measurable drift residue was detected at stations 31 and 36 in the elementary school yard and at stations 37 and 38 in the farm labor residences. Thermofax cards at station 31 revealed 0.2 µg of Phosdrin. A Phosdrin level of 0.8 µg was measured at station 37 (farm labor residences) and 6.6 µg was detected on Thermofax paper at the pond near station 38. A post-application water sample at station 38 contained a Phosdrin level of 0.9 µg/l.

Analyses of soil samples collected in the school yard at stations 30 and 31 showed pesticide residue levels of 0.02 µg/g. A soil sample collected near station 37 (farm labor residences) contained 0.03 µg/g Phosdrin residue.

High-volume air samplers were operated at eight locations on and near the field at stations 18, 24, 26 and 32 [Figure 2]. Additionally air-filtering devices were placed at locations remote from the field to monitor potential pesticide contamination of sensitive areas (stations 36, 37, 47 and 48). These automatic samplers collected a composite air sample during and following the pesticide applications.

The high-volume filtering device, operated at station 18, 6 m (20 ft) off the northeastern end of the field, collected the largest amount of Phosdrin drift (580 µg). This occurred as a result of heavy spraying as the helicopter passed directly over the sampling device. The next largest amount was found at station 32, about 30 m (100 ft) into the

Table 2

PESTICIDE RESIDUE ANALYSES (PHOSDRIN)
Monterey County, California
May 1977

Station No.	Sample Type	Phosdrin Residues	Detection Limits
	THERMOFAX PAPER (µg)		0.20 µg
4		ND†	
6		ND	
7		ND	
9		ND	
11		ND	
12		V†† = 0.20	
		H††† = 0.25	
13		ND	
14		ND	
15		ND	
17		V = 3.5	
		H = ND	
18		V = 12	
		H = 35	
19		V = 0.20	
		H = 0.20	
20		H = 0.20	
		V = 0.20	
22		ND	
23		ND	
24		V = ND	
		H = 0.80	
25		V = 120	
		H = 120	
26		V = 0.35	
		H = 0.75	
28		ND	
31		V = 0.20	
		H = 0.20	
33		V = 0.25	
		H = 0.20	
34		ND	
35		ND	
36		ND	
37		V = ND	
		H = 0.80	
38		V = 6.6	
		H = ND	
41		ND	
42		ND	
43		ND	
45		ND	
46		ND	
	HIGH-VOLUME FILTERS (µg)		0.2 µg
18		580	
24		60	
26		140	
32		190	
36		25	
37		72	
47		6.5	
48		8.0	
	ENVIRONMENTAL SAMPLES		
38	Water (µg/l)	0.90	0.2 µg/l
51	Pesticide Scan	ND	
30	Soil (µg/g)	0.02	0.004 µg/g
31		0.02	
37		0.03	

† *ND = None detected*
†† *V = Vertical position*
††† *H = Horizontal position*

field (190 µg). The two devices at stations 36 and 37, on top of the elementary school about 90 m off the field, and on top of the farm labor residences 15 m off the field, collected 25 and 72 µg of Phosdrin, respectively. High-volume air sampling devices near the Salinas Municipal Airport and on top of the Alisal High School contained 6.5 and 8.0 µg of Phosdrin, respectively [Figure 3]. However, these residues could not be attributed directly to the observed application, and may have resulted from applications in other areas because analyses of indicator cards between these areas contained no detectable Phosdrin residues.

Observers noted that spraying operations were occurring early on May 2, 1977, by another applicator approximately 0.8 to 1.6 km (0.5 to 1.0 miles) north to northeast of the target area. The pesticide applied at this time was not determined; however, drift contamination detected atop the high school could have resulted from these applications. A possible explanation of the residues collected at station 47, near the airport, is that this contamination may have resulted from spray droplets falling from one or more of numerous aircraft either leaving or returning to the airport mixing site.

Since irrigation water is largely recirculated in the Salinas Valley, a water sample was collected from a remote pond approximately 4 km (2.6 miles) northeast of the target field. A scan for common chlorinated pesticides was performed to determine if the high intensity pesticide applications in the area resulted in a persistence of some of these compounds. Chemical analyses for many of the more persistent pesticides failed to reveal identifiable pesticide residues.

Phosdrin is one of the most toxic organophosphate pesticides and is categorized Class I under FIFRA regulations. Label precautions warn that the material "should not be applied to areas occupied by unprotected humans or beneficial animals." During this application, the elementary school was in session with numerous children present in the playground

near the target field. Additionally, the farm labor residences were occupied, and unprotected children and adults were potentially exposed to spray drift. Also, numerous vehicles were observed traveling the farm roads bordering the target field.

The Phosdrin residues detected on the school yard and in the private residences were found to be lower than acceptable tolerance limits on lettuce eaten raw (0.5 mg/kg);[2] or 0.1 mg/m^3 of air (8-hr/day, 40 hr/wk occupational exposure) in working environments.[3] Reports received from school officials showing no increase in absenteeism indicated that the observed application had no discernible acute impact upon the health of the elementary school children. Nevertheless, the fact that drift cannot be completely controlled under any conditions creates a potential hazard when pesticides such as Phosdrin are being sprayed. Highly sensitive areas in close proximity to fields receiving spray should be protected. The field should be treated on weekends while school is not in session; residents should be notified and protected; and roads leading into an area should be posted or closed. Currently, California has a permit system in effect in which all of the above issues should be addressed.[1]

CLEANUP AND DISPOSAL

The Company had good cleanup and disposal facilities. Empty containers and refuse were placed aboard the nurse rig and returned to the plant for disposal. The closed system that was used for mixing and loading pesticides provided immediate and adequate rinsing of empty containers. At the plant site, 5-gallon containers were flattened by a mechanical crusher. This procedure ensured against accidental reuse of these containers. Larger drums were recycled. Other pesticide containers and general refuse were hauled to one of three dump sites in Monterey County for disposal. California State and County agencies

assume responsibility in monitoring these sites for proper security, handling and burial of containers.

NEIC personnel visited one of the Class II dump sites March 16, 1977. This sanitary landfill does not accept containers that are used for Class I materials unless they have been properly rinsed. The site visited contained proper signs explaining the conditions necessary before acceptance of the Class I containers [Figure 12].

Because cleanup of pesticide residue in the aircraft tank was delayed, it was not observed by the EPA inspectors. According to the pilot, when cleanup occurs, the mix tank is rinsed with approximately 150 liters (40 gal) of dilution water. The dilution water is then pumped into the aircraft spray tank and applied to the field that was treated with the parent mix.

A. Posted entrance to sanitary landfill.

B. Disposal area for used pesticide containers.

Figure 12. Sanitary landfill, Monterey County.

VI. EVALUATION OF METHODS

SPRAY DROPLET CARDS

The use of spray droplet cards to determine drift characteristics and spray droplet size was not successful during this study. However, the limitations of these devices were due to local environmental conditions, not the insensitivity of the cards. Heavy dewfall occurred prior to the first application and saturated the indicator cards. This masked spray droplet impressions and precluded droplet-size analyses.

Residue analysis of Linagraph and Kromecote versus Thermofax cards indicated laboratory pesticide extraction efficiency for Thermofax was superior. Results of pesticide residue recovery on Thermofax cards were not intended to be absolute values. These were only used to record relative amounts of drift detectable in different areas where drift was of concern. The fact that the cards contained excessive moisture may have caused the residue values to be conservatively low.

HIGH-VOLUME SAMPLING DEVICES

High-volume air sampling devices proved capable of capturing pesticide drift. Pesticide residue is captured on a dry fiberglass filter. This reduces the possibility of hydrolysis of pesticide residues; but it increases the possibility of evaporation of highly volatile pesticides. Therefore, values obtained from the high-volume samplers are qualitative. Relative values obtained are dependent upon time of operation and volume of air filtered. The high-volume filters were useful in that they detected relative amounts of residue in different areas.

ENVIRONMENTAL SAMPLING

Residue analyses of water and soil were useful in substantiating that drift occurred in the sensitive areas. It also indicated that the pesticide may be translocated by these media.

OBSERVATION AND PHOTOGRAPHS

Observations by EPA team members were the most valuable tool in substantiating the drift conditions. Photographs were most useful in recording storage and disposal facilities and mixing and loading operations.

PESTICIDE EFFICACY

The pest-control adviser used no standard procedure for evaluating the efficacy of the pesticide treatment. A random method of observing several lettuce plants was used. The advisor reported that the treatment caused an effective and satisfactory kill.

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DESCRIPTION OF SAMPLING DEVICES AND METHODS

SPRAY DROPLET CARDS

Spray card clusters were constructed by stapling Linagraph 480 (Light sensitive paper), Thermofax 209, type 640 (copy paper) and Kromecote photographic paper onto 15x20 cm (6x8 inch) poster-board. The poster-board clusters were attached with thumbtacks atop 30 cm (12 inch) square wooden platforms at one meter heights. Vertically positioned clusters were attached to the platform, with the flat side containing cards facing the target spray area.

HIGH-VOLUME AIR SAMPLERS

The high-volume sampler uses a high speed vacuum pump to draw air and airborne particles through a fiberglass filter. The system draws approximately 1 m^3/min (35 ft^3/min) of air through the filter. After gathering a composite sample, the filters were removed and folded into a small jar to which 100 ml of distilled water was added. The sample was then chilled on ice until analysis.

ENVIRONMENTAL SAMPLING

Samples of soil, water and sediment were collected by standard methods and chilled until analysis.

DESCRIPTION OF ANALYTICAL METHODS

Hi-Vol Filters

Water contained in the sample jars was decanted into a separatory funnel. The high volume filters were removed and rinsed with additional water which was also added to the separatory funnel. The water was saturated with NaCl, and extracted serially with two 50 ml portions of ethyl acetate. The ethyl acetate was concentrated to 10 ml in a Kuderna-Danish evaporative concentrator and analyzed using an alkali-flame gas chromatograph.

Thermofax papers

The Thermofax papers were wrapped in acetone-washed aluminum foil and individually packed in plastic bags for transit from the field to the laboratory. The samples were chilled in ice from the time of collection to the time of analysis. Each sample was dipped into 175 ml of ethyl acetate for approximately 5 minutes. The ethyl acetate extract was then filtered through a Whatman Number 1 filter paper into a Kuderna-Danish evaporative concentrator. The extract was concentrated to 10 ml and analyzed using an alkali-flame gas chromatograph.

Water

One liter of water was saturated with sodium chloride and extracted two times with 100 ml and 50 ml volumes of ethyl acetate, respectively. The combined extract was then concentrated to 10 ml in a Kuderna-Danish evaporative concentrator and analyzed using an alkali-flame gas chromatograph.

Soil

Fifty grams of soil was weighed into an Erlenmeyer flask. Ethyl acetate (150 ml) was added and the sample was shaken for 10 minutes. The ethyl acetate was then decanted and the process repeated with another 150 ml of ethyl acetate. The extracts were then combined, filtered through Na_2SO_4, and concentrated. Extracts were then analyzed on an alkali-flame gas chromatograph.

Pesticide Scan

A scan for common chlorinated pesticides was performed on a water sample collected at station 51. The sample was serially extracted with 100 ml and 50 ml volumes of hexane, concentrated to 10 ml on a Kuderna-Danish evaporative concentrator, and analyzed on an electron-capture gas chromatograph.